ASSESSMENT OF PRICE VOLATILITY IN THE FISH SUPPLY CHAIN IN UGANDA

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Marketing, Economic Risk Assessment, and Trade/Activity/16MER02AU

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Objectives

1. Evaluate the factors influencing fish price formation at the farm level (aquaculture) and whether or not fish prices at farm level have become more volatile over time.
2. Examine the price volatility relationships between aquaculture and captured fisheries.
3. Examine the degree of price volatility at the ex-vessel, retail and wholesale market levels, and use the results to forecast future fish prices.

Significance

Price fluctuations in the Uganda fish markets has become one of the main risks faced by fish producers. These price movements are for the most part risky, as the direction and force of the motions are largely unknown on a short-term basis. The economic costs of highly fluctuating prices are not only experienced by fish producers but are transferred to the entire value chain. Wholesalers, retailers and consumers increasingly demand stability of price and supply, and often have little understanding for biological and other mechanisms driving the formation of prices in the market. In view of this, price forecasting is becoming increasingly relevant.

At a basic level, fish prices are volatile because the short-run production and demand elasticities are low. On the demand side, the short-term elasticities are low because the producer price is a small percentage of the final retail fish price while on the production side, short-term elasticities are low because input decisions are made before new output prices are known. It is against this background that we are proposing to study the degree of price volatility in the Uganda fish supply chain.

By defining volatility as the fluctuations of prices above and below some pre-conceived long-term trend or equilibrium, the study will provide an approach to predict next-period fish prices based on the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) methodology.

An increase in price volatility implies greater uncertainty about future prices because the range in which prices might lie in the future becomes wider. As a result, fish producers and consumers can be affected by increased price volatility because it augments the uncertainty and the risk in the markets. More specifically, increased price volatility can reduce the accuracy of fish producers' and consumers' forecasts of future fish prices, thereby causing welfare losses to both fish producers and consumers. It is crucial for these decision makers to be aware of the degree of price volatility so as to be able to adopt appropriate hedging strategies.

The mobile app study (Investigation 2) and the volatility work proposed here are linked in several ways. Firstly, the forecasted prices information that will be generated from the volatility study will be disseminated to fish farmers and other stakeholders through the proposed mobile app. Sharing such information will create awareness among farmers on how well or bad the market is doing at a given

period, and will give farm managers a sense of future market prices and economic trends. Secondly, prevailing fish prices on the local markets gathered through the mobile app on a day-to-day frequency will be collected and incorporated into the baseline historical information database upon which future price forecasts will be based.

Quantified Anticipated Benefits

- Stocking decisions in the aquaculture sector are taken on the basis of expected prices at harvest; hence forecasting fish price empowers fish farmers to make informed decisions regarding stocking in the future.
- Increase sales and incomes for fish farmers
- Fish production become more market oriented and reduces post-harvest losses.
- Reduced marketing and other transaction costs for farmers.
- Improved market linkages and farm sales for farmed fish.

Research Design and Activity Plan

Location

Normal, Alabama and Kajjansi, Uganda.

Method

The proposed approach to precise measurement of price formation and volatility will involve presentation in both non-technical and technical forms.

Research task 1: Non-technical analysis (descriptive analysis*)*

In this analysis a number of different analyses (less advanced econometrically) of the price data will be conducted. The methodology will start by descriptively analyzing the behavior of price volatility in the fishery industry in central Uganda. We will apply several measures of volatility to monthly price data in order to apprehend indications of the properties of volatility that will in turn direct our further analysis. Particularly, we will use the following indicators to understand fish market price dynamics over time:

a. The Mean (arithmetic mean): the sum of all measurements in the period divided by the number of observations in the data set;
b. Volatility (variance): the dispersion of prices from their mean values (mathematical expectation of the average squared deviations from the mean).
c. The Coefficient of Variation: the ratio of the standard deviation over the mean as a measure of the dispersion of individual data. The higher the coefficient, the larger the dispersion and the higher the volatility of prices.
d. The Standard Deviation (σ): this shows how much variation or dispersion exists from the average (mean), or expected value. A low standard deviation indicates that the data tends to be very close to the mean; high standard deviation indicates that the data are spread out over a large range of values.
e. The Moving Average: price data will be analyzed by creating a series of averages of different subsets of the full data set. A moving average is commonly used with time series data to smooth out short-term fluctuations and highlight longer-term trends or cycles.

Moving Average techniques forecast prices by calculating an average of actual prices from a specified number of prior periods; each new forecast drops the prices in the oldest period and replaces it with the prices in the most recent period; thus, the data in the calculation "moves" over time.

Examination of the monthly fish price, production and consumption data to determine if certain factors including mobile phone coverage are significant in the formation of fish prices over time. Particularly, we will examine the impact of mobile phone coverage on producer price dispersion across markets. The following relationship will be estimated using OLS regression:

$$P = \beta_0 + \beta_1 \text{Production} + \beta_2 \text{Consumption} + \beta_3 \text{Mobile Phone Coverage}$$

where price (P) is defined as the price of fish while production and consumption are measured in tons (in thousands).

Research task 2: Seasonal price analysis (multiple regression)
Traditionally, farmers need only short-term predicted prices because fish is a perishable product, so this predication can permit some spatial and temporary arbitrage. However, traders and exporters need short, mid and long-term price predictions.

Regression analysis will be used to predict fish prices (the equation's outputs) for short-term (monthly prices), mid-term (quarterly) and long-term (annually) with the incorporation of dummy variables for detailed seasonal analysis (following the impact of particular months and quarters as these are the equation inputs).

A regression function will be specified as:

$$P = \beta_0 + \beta_1 * Month + \beta_2 * Q_{T1} + \beta_3 * Q_{T2} + \beta_4 * Q_{T3} + \beta_5 * Q_{T4}$$

where P is price; β_0 represents the coefficient for the intercept; β_1 to β_5 are slope coefficients; and Q_{T1} to Q_{T4} represent quarters.

Research task 3: Measuring volatility and price forecasting (GARCH approach)
For the aquaculture industry providing information on the volatility of prices is potentially valuable. There is substantial variability in industry profit levels, and an important part of this variability is due to fluctuating prices. Particularly, we will investigate the price volatility in the catfish industry, and thereby obtain information with respect to the nature of price risk that catfish farmers are facing.

To put the aquaculture sector into a broader perspective, we will compare it with capture fisheries. Dahl and Oglend (2014) showed that capture fisheries, which are exposed to both the risks of production (catch volume and type) and market price fluctuations, tend to have more volatile prices than aquaculture, which mitigates some of the production risk, thus lowering volatility.

The working hypothesis is that as aquaculture industry grows and accounts for an increasing portion of Uganda's fish market, overall fish prices should become less volatile. We will measure price volatility by using the generalized autoregressive conditional heteroscedasticity (GARCH) approach by estimating two different multivariate GARCH models, i.e. the DVEC(1,1) and the BEKK(1,1) models.

The analysis will relate asymmetries in the price transmission mechanism (addressed in the last study) and changes in price volatility by incorporating regime variables into the conditional variance covariance matrix of the estimated multivariate GARCH models. The models can be represented as GARCH (p, q):

$$\varepsilon_t = \nu_t \sqrt{h_t}$$

where ν_t is white noise term and

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-1}^2 + \sum_{i=1}^{p} \beta_i h_{t-1}$$

defining the conditional variance. Similar work by Buguk et al., (2003) used an exponential GARCH model to test univariate volatility spillovers in the US catfish supply chain.

Trainings and Deliverables

Item	Mechanism (*e.g. podcast, reports, factsheets).*
Historical price trends in the fish industry	Technical report for extension.
Information on price volatility, price forecast and policy recommendations	Technical report for extension.

Schedule

	2016		2017			
	3rd	4th	1st	2nd	3rd	4th
Data Entry and Cleaning		x				
Data entry and analysis using LIMDEP software		x	x	x	x	
Developing policy recommendations & leaflets					x	x
One presentation to farmer conference			x	x	x	x